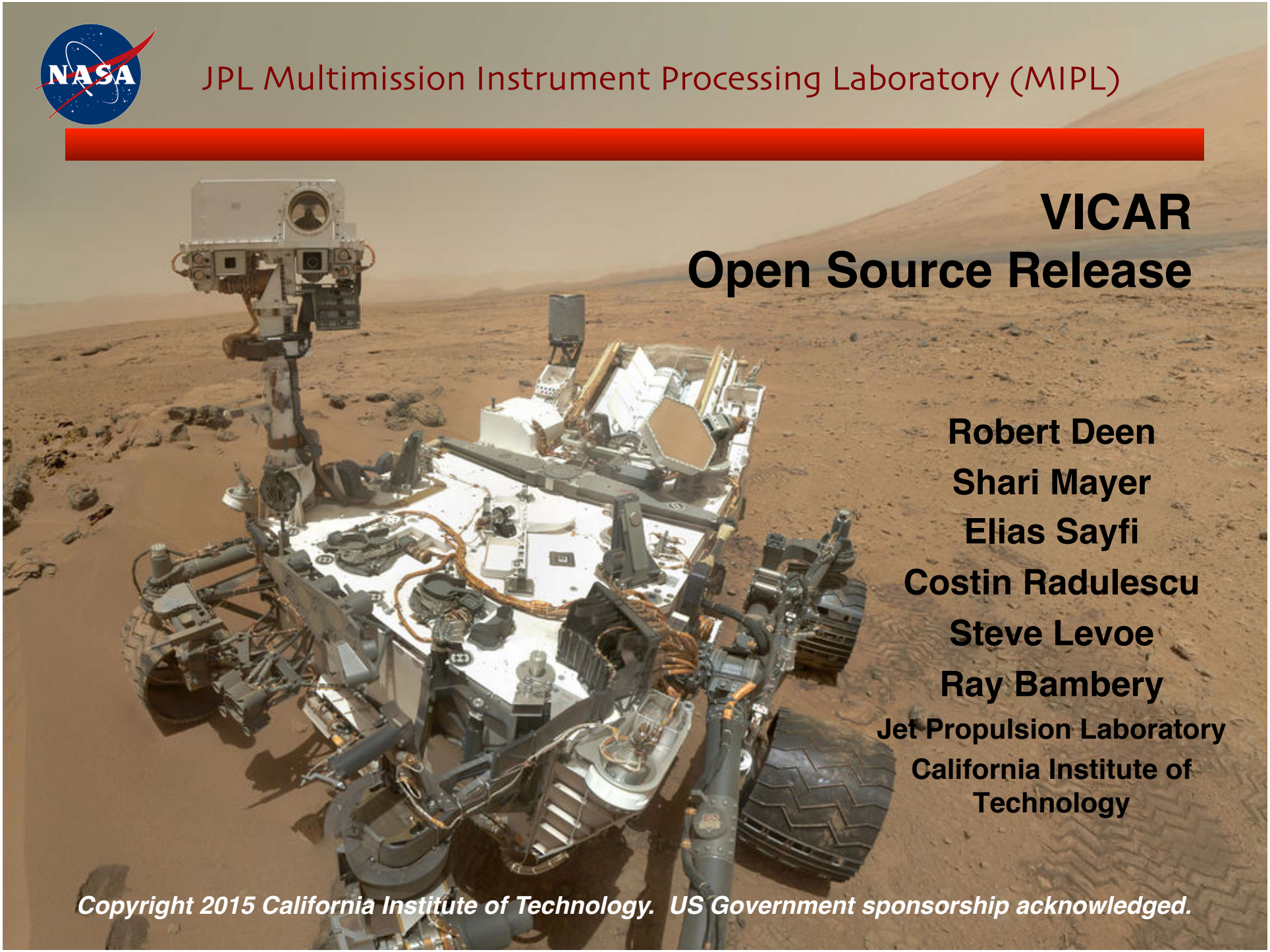

JPL Multimission Instrument Processing Laboratory (MIPL)

VICAR
Open Source Release

Robert Deen

Shari Mayer

Elias Sayfi

Costin Radulescu

Steve Levoe

Ray Bambery

Jet Propulsion Laboratory

California Institute of Technology

What is VICAR?

- **Video Image Communication And Retrieval (VICAR)**
- **Image processing system developed at JPL**
  - Used primarily but not exclusively for planetary image processing
- **Command-line oriented system**
  - > 400 applications (almost 350 for the open source version)
  - VICAR is not Photoshop – don't expect flashy GUI's
- **Applications are strung together to accomplish tasks**
  - Great for scripting
- **Simple file format**
  - Designed for efficient metadata handling
  - Uncompressed, making random-access reads and writes easy
  - Supports large (>>2GB) images
  - Supports many data types (byte, short int, long int, float, double, complex)
- **Extensive metadata support**
  - "Labels" embedded in the image
  - Describe how/when/where the data was taken, spacecraft state, temperatures, processing history, mapping parameters, pixel units, etc.

Brief History of VICAR

- **1962/3 – Bob Nathan proposes image processing at JPL**
- **1964/5 – Fred Billingsley (first publisher of "pixel") and Roger Brandt develop Video Film Converter (digitizer); Howard Frieden develops code to process Ranger data on IBM 7094**
- **1966 – First published reference to VICAR; IPL (Image Processing Lab) formed**
  - Written by Stan Bressler, Frieden, Nathan, Billingsley, et al
  - First documented use with Surveyor
  - Originally developed for IBM 360 computers
- ***We believe, but cannot prove, that this makes VICAR the oldest continuously used image processing system in the world***
- **1971 – First "Open Source" delivery of VICAR (via COSMIC)**
- **1973-4 – Interactive processing on IBM/TSO introduced**
- **late 1970's – IBIS developed (tabular data support)**

VICAR History (cont'd)

- **1984 – VICAR converted to VAX/VMS**
  - Multimission Image Processing Lab (MIPL) formed
  - VICAR core redesigned to support VMS transition
    - Much application code survived the transition
  - VICAR file format redesigned to current state
    - Sometimes called VICAR2
  - TAE (Transportable Applications Executive) adopted as command line/ batch/script processor
    - Also adopted by early versions of ISIS
- **Early 1990's – VICAR ported to Unix**
  - Many Unix variants supported
  - "Shell VICAR" removed reliance on TAE command line
- **Mid 1990's – Open Source releases suspended**
- **1994 – "xvd" display program developed**
- **2003 – Marsviewer display program developed**
- **2004 – VICAR ported to Mac OS X**
- **2005 – VMS support discontinued**
- **2015 – VICAR core again released Open Source**

Why Release Now?

- **Motivated by discussions at 1st Planetary Data Workshop, 2012**
- **Almost all potential users want/need source code**
- **VICAR has long history of Open Source**
- **No need to keep it proprietary**
  - Growing ITAR concerns motivated retreat from Open Source in the mid 1990's
  - ITAR has become somewhat more lenient of late
  - Potential ITAR code (e.g. telemetry processors) has been removed from the release
- **JPL is encouraging Open Source much more now**
  - Used to be very hard to get approvals
  - Requirement that code be posted at Open Channel has been lifted
    - SourceForge, GitHub, etc. now are valid options

Current VICAR Users

- **MSL, MER, InSight, Mars 2020**
  - Large Mars processing suite built on VICAR
    - Mars suite not being released at this time (licensing concerns)
  - Extensive use of VICAR core capability
- **AFIDS (Automatic Fusion of Image Data System)**
  - State-of-the-art Earth mosaic/cartography system
    - Automated subpixel registration, orthorectification, huge (>> 2GB) mosaics
  - Extensive DoD users
  - Integrates many open source tools with VICAR core processing
- **Cassini**
  - Telemetry processing
  - Cassini-specific applications for data validation and analysis
  - Mapping, photometric analysis, navigation (pointing correction)
- **Mars Express (DLR, Berlin)**
  - HRSC camera processing

Current VICAR Users (cont'd)

- **PDS Rings Node, NASA ROSES (e.g. PDART) proposals**
  - Voyager reprocessing
- **Earth processing**
  - Classification/Segmentation, change detection, large mosaics, multi-band processing
  - Detect thermal infrared anomalies in orbital data
  - Cloud detection
- **PDS Data Archive**
  - Image data for many planetary missions is stored in VICAR format with attached or detached PDS labels
  - MSL, MER, Phoenix, Cassini, Galileo, Voyager, Magellan, MEX(HRSC), many older missions
  - InSight and Mars 2020 (ecam) will use this same delivery concept with PDS 4
    - VICAR images with detached PDS 4 labels

What's Included

- **Almost 350 application programs**
- **Command-line parsing (shell) and optional environment (TAE)**
- **VICAR-format image I/O library**
  - Both C/C++/Fortran and Java versions
- **File Format Conversion ("transcoder")**
  - Convert between most common file formats
    - Including VICAR, PDS, ISIS, FITS
  - Preserves metadata
- **"xvd" image display program**
- **IBIS (Image-Based Information System) for tabular data**
  - Efficient handling of large data sets

Sample Application Program Types

- General Image Manipulation
- Contrast Enhancement and Color Processing
- Map Projection and Image Warping
- Statistics and Mathematics Functions
- Filtering
- Mosaicking
- Label Manipulation
- Registration
- Classification
- Segmentation
- Graphics and Annotation
- Feature Detection and Location
- Blemish and Noise Removal
- Photometry/Radiometry
- Multispectral Analysis
- Image Calibration (Generation and Use)

Supported Platforms

- **Fully tested, supported platforms**
  - Linux (32 bits)
  - Solaris 10
- **Available platforms (limited testing due to resource constraints)**
  - Linux (64 bits)
  - Mac OS X
  - In reality, these work fine

Available Documentation

- **Overall system documentation is generally old and not well maintained**
  - Accurate as far as it goes, but usually does not include recent developments
  - Getting Started guide is current
    - Start there for an overall picture, including notes on the relevance of other documents
- **Individual program help is generally relevant and useful**
  - "PDF" format ***TEXT*** files contain detailed help on each program
    - Parameter Definition Files
    - Not Adobe PDF files!!
      - We had the name long before Adobe PDF was invented
  - PDF files are also converted to HTML for ease of browsing

Where to Get It, and Release Status

- **Currently obtaining final approvals**
  - Hoped to be done by this conference, but still working the final approvals
  - Should be very small number of weeks
- **Look for it (or status updates before release) here:**

http://www-mipl.jpl.nasa.gov/vicar_open.html

Questions?

- Bob.Deen@jpl.nasa.gov
- Shari.C.Mayer@jpl.nasa.gov
- Elias.M.Sayfi@jpl.nasa.gov
- Costin.Radulescu@jpl.nasa.gov
- Steven.R.Levoe@jpl.nasa.gov
- Raymond.J.Bambery@jpl.nasa.gov